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# Kenai Lake



***BURN***

***REGENERATION***

***PROJECT***

**CHUGACH NATIONAL FOREST      1962 & 1965**

**U.S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE      ALASKA REGION**

**FEBRUARY 1969**



KENAI LAKE BURN REGENERATION PROJECT

1962 - 1965

Chugach National Forest

By

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and

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U. S. DEPARTMENT OF AGRICULTURE  
Forest Service    Alaska Region  
Division of Timber Management  
February, 1969

## REPORT ON KENAI LAKE BURN REGENERATION PROJECT

### Introduction

In June, 1959, a fire occurred on the southwestern shore of Kenai Lake which burned 3,200 acres of National Forest land. The topography varied from flat to near 100 percent at the upper edges of the burn. The pre burn climax vegetative type was white spruce mixed with mountain hemlock and aspen, birch and willow mixed in the subclimax. About 1,104 acres within the burn area would have been considered commercially operable timber. The fire burned on the ground only in some areas, in the crowns only in other areas and both on the ground and in the crown in still other areas. In only a small portion of the fire was the organic material completely burned to mineral soil. In the old fire line, reproduction was visible in 1961. Some natural regeneration was showing in 1962, but not over the entire burn. Lack of established reproduction throughout the burn was due to poor seed years and poor seed bed conditions; lack of seed probably being the more important of the two. An administrative study was initiated in 1962 to determine successful techniques and costs of speeding reforestation on the burn for application on similar depleted areas in the future. This program was carried out by the personnel of the Kenai Ranger District.

### Purpose

The objective was to determine the most effective and economically feasible method of reforestation in the white spruce type of Region 10. This report deals primarily with this objective.

Two basic procedures were used in the Kenai Lake Burn Reforestation program.

The first method was a system of spot scalping and direct seeding of the prepared spots. The second method was a general scarification program using heavy equipment with the area being broadcast seeded later.

### Spot Scarification and Seeding Phase

#### General - Winter, 1962

The spot scalping and seeding phase began in December, 1962. The area which was seeded is located at the northwestern end of the burn. (See Appendix map.) Slope average 10 - 15 percent. Snag

density was medium and average d.b.h. was approximately 12 inches. Brush was light and presented no major problems. Seed was purchased from the Manning Seed Company, collected on the Kenai Peninsula. Germination percent averaged 75 percent.

### Procedure

Equipment used in the project is as follows: (1) White spruce (*Picea glauca*) seed treated with endrin, (2) rubber gloves with liners, (3) glass jars (1 pint) with 1/8 inch holes in the metal lids, (4) pulaskis, (5) orange flagging, (6) tally counters, (7) aerial photos, (8) tree marking gun and paint, and (9) 1/4 x 2 inch x 16 inch survey stakes.

The number of men working on the project varied from three to five, including the forester who supervised the work and served as a crew member. Crew organization varied with the number of men on the project each particular day. Basically, the organization consisted of two groups. One group, termed the diggers, would do the spot scalping. The other group, the seeders, would do the seeding and covering of the seed. Ideally there should be three diggers for each seeder.

When work started, the diggers formed a line across the slope, spacing themselves 10 feet apart. They then moved up the hill using the hoe end of the pulaskis to dig a small hole (approximately 1/2 square foot) down to mineral soil. A 10 foot x 10 foot spacing was used throughout, producing 435 seed spots per acre. In order to maintain control of line direction and spacing, the lead digger would follow a flag line indicating the position of the seed holes of the last row. The other diggers would space themselves at 10 foot intervals across the slope. The end man would flag the position of his holes. On the return pass, the end man would follow his own flag line back, thus becoming the new lead man and the new end man would flag the position of his holes.

Seeders would then follow and from pint jars, shake 12-25 seeds in each hole. They then covered each hole by kicking a small amount of soil over the seeds. Each seeder would keep track of the number of spots he seeded each day so acreage could be determined.

In order to check seed germination and seedling survival, survival plots were located diagonally across the seeded acres. A tree marking gun was used to temporarily mark the plots. As soon as the ground thawed, stakes were driven at each plot as permanent markers. Location of each seeded area and test area was marked on photos. One hundred survival plots were established.

### General - Spring, 1963

The spot scalping and seeding project was continued in May, 1963. Again the work was carried out at the northwestern end of the burn. The slope averaged 10 - 15 percent. Average snag d.b.h. was 14 inches, density was medium to heavy. Brush was heavy throughout 10 percent of the area and medium to light in the remaining 90 percent.

### Procedure

The work was carried out exactly as it had been in the winter project with one exception. There being no opportunity for natural stratification, it was necessary to do this artificially. The seeds were first soaked overnight in water, then placed in plastic bags, using caution to see that they were thoroughly soaked. The bags were then placed under refrigeration ( $38^{\circ}$  -  $40^{\circ}$ ) for fifteen days. At the end of this fifteen day period, the seeding was carried out as in the winter work. One hundred additional survival plots were established.

In May, 1965, an additional area was scalped and sealed on the southeastern side of the burn. On the first two days of work ground conditions were poor. Slope was steep and reached a maximum of 35 percent. Work was hampered by much down timber and dead alder. Duff was exceptionally thick. No frost was in the ground. On the last two days conditions were somewhat easier. Slope was considerably less and down timber was less abundant.

### Procedure

The procedure used in this project was exactly the same as in May, 1963. The seed was artificially stratified and then planted. A four-man crew was used each day - 3 diggers and 1 seeder.

### Results

During the fall of 1963, the 200 survival plots of the 1962-1963 project were checked. Results indicated that 78 percent of all spots had at least one seedling. The average number of seedlings for the 200 spots was found to be 4.5. The maximum number found was 20. On June 17, 1965, the survival plots were again checked. Results showed 76 percent of all spots had at least one seedling and the average number of seedlings per spot was 3.9. The maximum number found in one spot was 20.

No significant differences were noted between spots seeded with naturally stratified seed and artificially stratified seed. Slight

differences were noted within the various microenvironments where spots were located. Spots located in duff or under rotten logs showed a slightly higher average number of trees per spot and a slightly lower number of spots with no seedlings. No significant differences were found between the other microenvironments classed as deep moss, light moss and mineral soil.

In December, 1962, spot scalping and seeding work showed a total of 300 man hours used with a total accomplishment of 48.4 acres. This yields an average of 0.16 acres per man hour. During the May, 1963, project, 240 man hours were used with an accomplishment of 32.68 acres and an average of 0.14 acres per man hour. On the May, 1965, project a total accomplishment of 10.93 acres was recorded with 104 man hours for an average of 0.10 acres per man hour. Times indicated above do not include travel time and reflect only hours spent in the woods. Appendix tables 1, 2, and 3 indicate manhour accomplishments broken down by crew size.

The average cost per acre for the December 1962 project was \$42.52, with an average of \$39.06 for the May 1963 project and \$57.08 for the May 1965 project. (See Appendix tables 5, 6, and 7 for detailed cost breakdown.)

The high cost figures shown for the May 1965 work are due primarily to the rough working conditions encountered on the project. Also, the cost of preparation for this small job is only slightly less than that needed for larger jobs.

#### Conclusions and Recommended Techniques

Spot seeding and scarification seems to be a very effective way to reforest denuded areas in the white spruce type. Germination and survival seem to be good. Surrounding brush and snags tend to keep desiccation at a minimum and frost heaving is nominal. Some evidence was found of a rodent problem. The rodents responsible for the damage to seedlings were probably mice. They nipped off all the leaved portion of the seedlings, killing the plant. This was very minor; less than 5 percent of the seedlings were killed.

Although this is a highly effective method of reforestation, the seeding costs were high. Results of this study indicate that with a four man crew, only 0.14 acres per man hour are seeded. In good terrain, this may rise to 0.20 acres per man hour, but in burns with many dead falls and steep terrain only 0.09 acres per man hour may be reached. Note that this does not include travel time to and from the project because this was a study of planting costs and travel time would vary on other projects.

A four man crew seemed to be more efficient than either a three or five. The four man crew would include three diggers and one seeder. Although the figures found in table 1, 2, and 3 of the appendix do not demonstrate this conclusively, foresters involved in the project feel it is true. When a five man crew is used the seeder cannot keep up with the four diggers. If a three man crew is used the seeder is often idle.

Ground conditions seem to be the principle factors affecting the efficiency of spot seeding operations. Although steep terrain is one factor which hampers operations, the presence of deadfalls and brush is the greatest deterrent. In the December 1962 and May 1963 work, averages of 0.16 and 0.14 acres per man hour were realized. These areas had gentle slopes and little brush and deadfall. However, in the May 1965 project, only .10 acres per man hour were realized due to steep slopes and heavy brush and windfall. Depth of frost did not have any detrimental effect on time required for scalping, or effectiveness of scalping. If anything, it helped the diggers. Moss and organic material were frozen and easily penetrated by the pulaskis. When the frozen soil layer was encountered, the moss and organic material readily separated, leaving a clean break at the top of the mineral soil. This layer was easily removed and seed applied to the mineral soil. For ease of accomplishment, these conditions were better than when the ground was unfrozen.

The following is a list of recommended techniques which should be followed in future spot scalping and seeding projects: (1) A four man crew should be used. Three of these should be diggers and one a seeder. (2) A glass jar should be used as a seed dispenser. Seeders can see exactly how much seed they have at any time. (3) Seed rows should be kept as short as practical. This maintains good alignment and gives workers a psychological advantage in that they have a shorter goal to shoot for. (4) Seeding rows should run up and down the slope. The seeder thus moves along the side hill instead of up and down. (5) Seeding areas should be kept in blocks as much as possible. This allows easier plotting on photos. (6) Men doing this work should be given a 10 minute break at least every hour to maintain safety and morale.

### Tractor Scarification and Broadcast Seeding

#### General

For cost comparison purposes, one additional method was used. The area was scarified by dozer using a brush blade, and subsequently broadcast seeded by hand.



The areas scarified had a slope of less than 12 percent. Snags averaged 14 inches d.b.h. Density was medium. Frost was more than 5 inches below the surface.

### Methods

A tractor scarification work was done in June 1964. The work was carried out near the C.E.A. substation in the burn. A D-6 cat was hired to do the work at a cost of \$18.00 per hour. The cat had an angle dirt blade converted to a brush blade. Five teeth were welded to the blade and protruded one foot below the bottom edge of the blade. Width of the blade was 9 feet.

A District forester worked with the operator throughout the entire job to (1) keep time, (2) maintain acceptable standards of work, (3) establish methods of treatment, and (4) select areas for treatment. Selection of areas to be treated was based on the following criteria: (1) topography, (2) density and d.b.h. of dead timber, (3) depth of frost, and (4) presence of existing seedlings and green timber.

Three methods of scarification were used on the project. Each method was essentially the same except for the fact that various spacings were used between passes. With Method A, distance between passes was 2 feet, 5 feet with Method B, and 8 - 10 feet with Method C. Throughout the entire project, the cat made one pass over a given area. At no time was a track retraced to obtain a higher degree of scarification. No effort was made to keep passes exactly straight or to knock out all dead timber. Large stems were avoided by going around as much as possible. No effort was made to miss small trees that the cat could roll right over with no loss of time. All passes were made along the contour to prevent erosion. The time required to do each section was recorded so that an adequate comparison between methods could be made.

During and immediately after scarification, sixty acres were seeded. Seed was sown by hand at the rate of .17 pounds per acre. In May 1965, 29 additional acres were sown at the rate of .20 pounds per acre. (For details on areas treated, methods, areas seeded, see Appendix and map.)

### Results

A total of 152 acres were scarified in 88.25 hours for an overall average of 1.72 acres per hour. Method A was applied to sections A, B, D, and D totaling 38 acres. (See map.) Total cat time was 19.25 hours for an average of 1.97 acres per hour. Method B was



was applied to sections E, F, and G totaling 68 acres. Cat time was 47 hours for an average of 1.45 acres per hour. Method C was applied to section H totaling 46 acres. Cat time was 22 hours for an average of 2.09 acres per hour. (See map and Appendix for summary.)

Although no plots have been taken in the areas scarified by cat and then seeded, District personnel have made a number of general inspections. Their findings indicate that germination was quite low. Seeds that did germinate suffered heavy mortality through desiccation and frost heaving. Although a far from optimum catch was achieved, all areas seeded have some seedlings remaining which look healthy.

#### Conclusions and Proposed Techniques

Although the results of this project were unfavorable, it is felt that this method might prove useful where different soil types exist and frost heaving presents less problems. Regional soil experts state that the area of the Kenai Lake Burn is covered by a thin layer of volcanic ash. When the vegetation, moss, brush, weeds, etc. are removed, desiccation of small seedlings in this ash is high.

If tractor scarification is used again in R-10 burns, it is felt that Method C should be favored. Where passes were 8 feet - 10 feet apart, as in Method C, adequate scarification was achieved without overdoing the job. Methods A and B led to over-scarification. (See Appendix table 4 for complete summary and map for complete summary and map for location of areas.)

Several problems were encountered which impaired operations. Areas where low stumps are present cause problems in that the cat tends to become high centered. It is usually a simple matter to winch the cat off but production is lost.

Where frost is less than 3 inches deep, tractors have trouble gaining traction. This is particularly bothersome on side slopes or where heavy pushing is required.

Problems also exist where you have a dense snag stand with large stems (+16 inch d.b.h.). Much production is lost in trying to work in this type of situation. Where you have only occasional large stems it is no problem to go around them. Dense stands of small snags also present no problem in that the cat can roll across them. (The up-rooting of these small stems helps form an excellent seed bed.)

Boggy ground should be avoided in all cases. No time was lost in this operation due to being stuck because all questionable areas were avoided. One primary problem which caused considerable delay was that the cat had no rock guards. Much of the area had a considerable amount of rock in it which caused the cat to run off its tracks on several occasions. Time lost in this manner was not considered as operational time so did not affect the validity of this study or the cost of the program. A certain amount of breakdown time should be included in project cost estimates.

Topography was another constant problem. As all operation was along the contour, the cat had a greater tendency to jump the track because of slope than it would have if work had been up and down the slope. In general, slopes in excess of 15 percent were avoided.

A total of 99 acres or 65 percent of the scarified area was seeded. These were Sections A, B, C, D, E, and G, and a portion of H.

All seeding was done by hand as it was found that the wet seed which had been artificially stratified would not feed through the cyclone seeder. The following is a list of recommended techniques to follow in future scarification projects: (1) Give preference in scarification work to large areas. This eliminates travel time from one area to another. (2) Give preference to areas as long as possible to reduce time lost in turning. (3) Avoid working in areas with low stumps. (4) Avoid working in areas where the frost is less than 3 inches below the surface. (5) Do work in areas where you can get fuel close to work points. If this is possible use a sled or trailer to haul fuel to work points. This eliminates dead head time. (6) Do not attempt work in areas of large dense snags. (7) In timber 1 inch - 18 inch d.b.h. of medium density, a D-6 cat with a brush blade should be used. (8) Do not work on side slopes in excess of 15 percent. (9) Use the highest safety precautions. Make and use a safety plan. Make sure cat has canopy, all people in area have on hard hats, and allow no one in work areas in high winds. Never allow men to work down hill from a working tractor.

#### General Conclusions and Summary

Considering the two methods, tractor scarification and broadcast seeding was the least expensive but also least successful considering survival. Hand scalping and spot sowing was more expensive but resulted in good survival. As the report indicates, spot seeding was a very effective way of reforesting denuded white spruce types, but under the best conditions the results will not compare

with natural seeding. In 1963, more natural seed fell on the Kenai Lake Burn in a few minutes than we applied from 1962 to 1964. We had to wait from 1959 to 1963 to get this seed fall, but in the end we got the same results. Therefore, this study indicated that in only exceptionally large burns without seed source would artificial seeding be necessary to assure adequate regeneration. It may prove economical in some instances to seed high value commercial forest lands to insure fast and complete restocking.

APPENDIX TABLE #1

SUMMARY SHEET FOR SPOT SCARIFICATION AND SEEDING PROJECT  
December, 1962

Day No.	No. on Crew	Hours Worked	No. of Holes/ Crew	No. of Holes/ Hr/Crew	No. of Holes/ Hr/Man	Acres per Crew	No. of Acres/ Hr/Crew	No. of Acres/ Hr/Man
1	4	4.5	1047	233	58	2.40	0.53	0.13
2	4	6.0	1834	306	76	4.21	0.70	0.17
3	5	6.0	1785	297	59	4.09	0.68	0.11
4	4	6.0	1657	276	69	3.80	0.63	0.15
5	3	5.0	1207	241	80	2.77	0.55	0.18
6	4	6.0	2137	356	89	4.90	0.82	0.20
7	3	6.0	1387	231	77	3.18	0.53	0.17
8	3	4.0	540	135	45	1.24	0.31	0.10
9	4	4.5	1011	225	56	2.32	0.51	0.13
10	4	6.0	1812	302	75	4.16	0.69	0.12
11	4	6.0	1639	273	68	3.76	0.63	0.16
12	3	5.0	1207	241	80	2.77	0.55	0.18
13	4	6.0	2132	355	88	4.89	0.81	0.20
14	3	6.0	1314	219	73	3.02	0.50	0.17
15	3	4.0	400	100	33	.92	0.23	0.08
Total	55	81.0	21109	3790	1026	48.43	8.67	2.25
Aver.	3.7	5.4	1407	253	68	3.23	0.58	0.15

Over-all Average No. of acres/man/hour -0.15

Average No. of Acres/man/hour, 4-man crew -0.16

Average No. of Acres/man/hour, 5-man crew -0.11

Average No. of Acres/man/hour, 3-man crew -0.15

Total acres seeded - 48.46

APPENDIX TABLE #2

SUMMARY SHEET FOR SPOT SCALPING AND SEEDING PROJECT  
May, 1963

Day No.	No. on Crew	Hours Worked	No. of Holes/ Crew	No. of Holes/ Hr/Crew	No. of Holes/ Hr/Man	Acres per Crew	No. of Acres/ Hr/Crew	No. of Acres/ Hr/Man
1	4	7.5	1129	150	37.5	2.59	0.35	0.09
2	4	7.5	1995	266	66.5	4.58	0.61	0.15
3	4	7.5	2214	295	74.0	5.08	0.68	0.17
4	4	7.5	1770	236	59.0	4.06	0.54	0.14
5	5	6.0	1600	267	53.0	3.67	0.61	0.12
6	4	7.5	1364	182	45.5	3.13	0.42	0.10
7	4	7.5	1965	262	65.5	4.51	0.60	0.15
8	4	7.5	2204	294	73.0	5.06	0.67	0.17
Total	33	58.5	14241	1952	474.0	32.68	4.48	1.09
Aver.	4.1	7.3	1780	244	59	4.08	0.56	.14

Over-all Average No. of Acres/man/hour -0.14

Average No. of acres/man/hour - 5 man crew -0.12

Average No. of Acres/man/hour - 4 man crew -0.14

Total Acres Seeded - 32.69

# APPENDIX TABLE #3

## SUMMARY SHEET FOR SPOT SCALPING AND SEEDING PROJECT May, 1965

Day No.	No. on Crew	Hours Worked	No. of Holes/ Crew	No. of Holes/ Hr/Crew	No. of Holes/ Hr/Man	Acres per Crew	No. of Acres/ Hr/Crew	No. of Acres/ Hr/Man
1	4	6.5	1023	157	39	2.35	0.36	0.09
2	4	6.5	1062	163	41	2.43	0.37	0.09
3	4	6.5	1283	197	49	2.94	0.45	0.11
4	4	6.5	1400	215	54	3.21	0.49	0.12
Total	16	26.0	4768	732	183	10.93	1.67	0.41
Aver.	4	6.5	1192	183	46	2.73	0.42	0.10

Average No. of Acres/man/hour - 4-man crew - .10

Total acres seeded - 10.94

# APPENDIX TABLE #4

## SUMMARY SHEET FOR TRACTOR SCARIFICATION AND BROADCAST SEEDING PROJECT

Section	Acreage	Method	Tractor Hours Worked	Aver. No. Acres/ Hour	Topography	Seeding Information	Remarks
A	19	a				Seeded Spring, 1964	No Heavy
B	5	a	19.25*	1.97	Flat or Gentle	Seeded Spring, 1964	Timber, Going
C	8	a			Side Slope	Seeded Spring, 1964	Extremely Good
D	6	a				Seeded, Spring, 1964	
E	9	b				Seeded, Spring, 1964	
F	30	b	47.00*	1.45	Side hill 10-15%	Not seeded control area	Heavy Timber, Going
G	29	b				Seeded, Spring, 1965	Rough
H	46	c	22.00*	2.09	30% of Area - 10-15%, 70% of Area - 0-5%	50% Seeded Spring, 1964 50% not Seeded Control Area	Generally Favorable Going
Total	152		88.25				

\* Times include ferry time from work area to fuel dump and return (Approximately 3% of total time)

Method A - 2' spacing  
Method B - 5' spacing  
Method C - 8-10' spacing

Note: Section I shown on map is included in Section G above.



APPENDIX TABLE #5

COST SUMMARY

SPOT SCARIFICATION AND SEEDING PHASE  
December, 1962

Labor.....	\$1766.16
Seed.....	132.00
Miscellaneous Supplies.....	25.00
Travel.....	136.00
TOTAL.....	\$2059.16
Average Cost/Acre.....	\$42.52

APPENDIX TABLE #6

COST SUMMARY

SPOT SCARIFICATION AND SEEDING PHASE  
May, 1963

Labor .....	\$1088.56
Seed .....	88.00
Miscellaneous Supplies .....	20.00
Travel .....	80.00
TOTAL.....	\$1276.56
Average Cost/Acre .....	39.06

APPENDIX TABLE #7

COST SUMMARY

SPOT SCARIFICATION AND SEEDING PHASE  
May, 1965

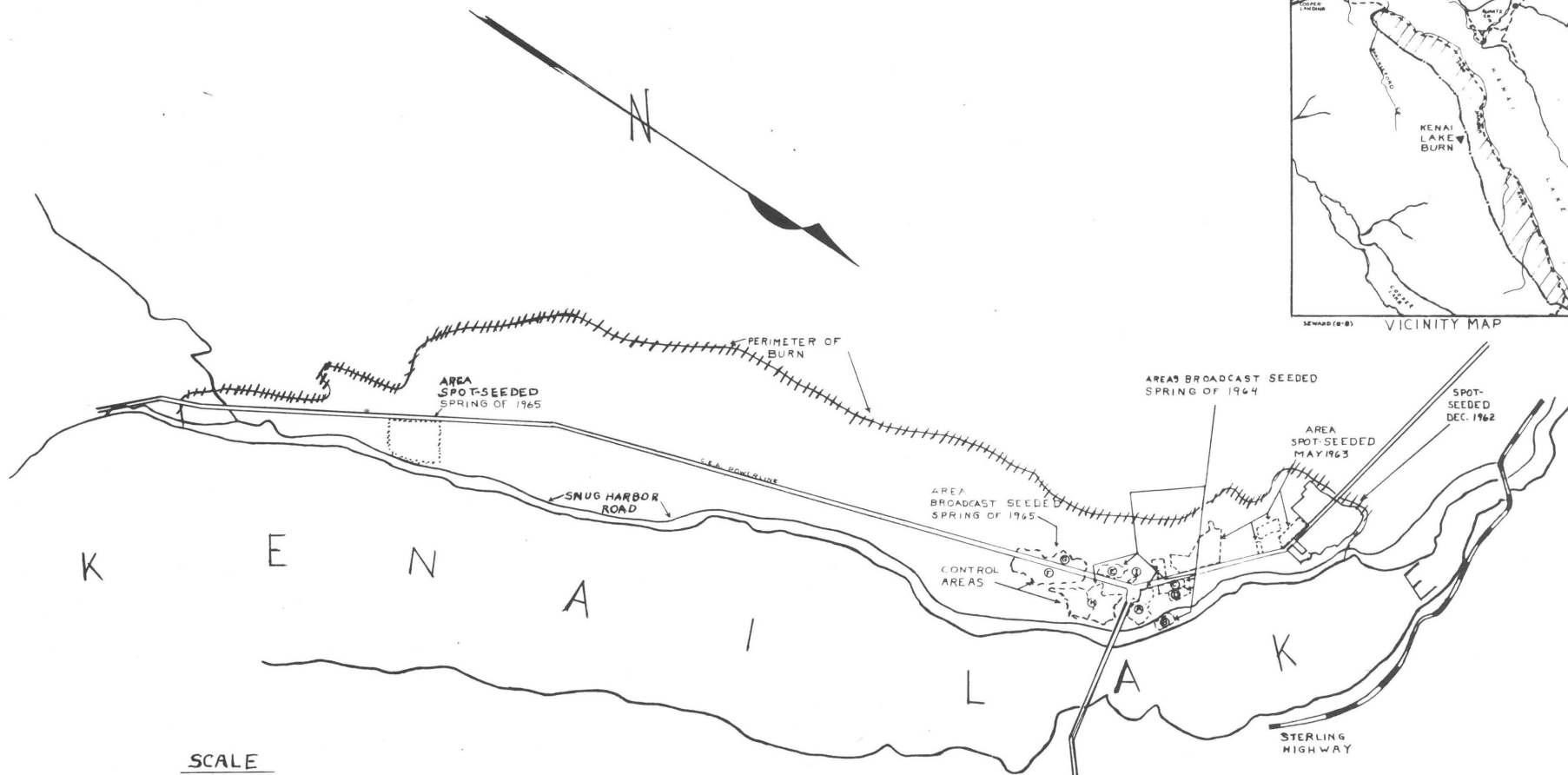
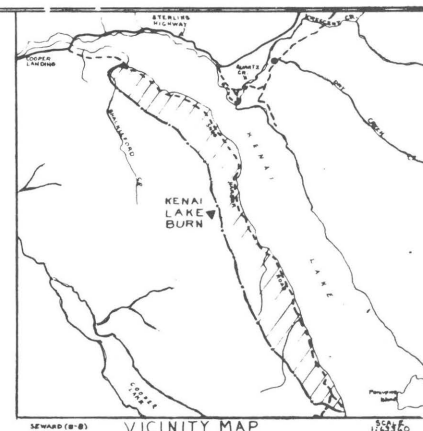
Labor .....	\$528.88
Seed .....	37.00
Miscellaneous Supplies .....	10.00
Travel .....	48.00
TOTAL .....	\$623.88
Average Cost/Acre .....	57.08

APPENDIX TABLE #8

COST SUMMARY

TRACTOR SCARIFICATION AND BROADCAST SEEDING PHASE

Tractor .....	\$1588.50
Labor .....	602.80
Seed .....	583.00
Travel .....	240.00
TOTAL COST .....	\$3022.30
AVERAGE COST/ACRE .....	\$19.88



SCALE  
1" = 20 CHAINS

PHOTOS USED : LEV-48-12, LEV-48-111, 10114, LEV-45-144

APPROVED _____	DATE _____	DESIGNED _____	DATE _____
APPROVED _____	DATE _____	APPROVED _____	DATE _____
APPROVED _____	DATE _____	APPROVED _____	DATE _____

U.S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE  
CHUGACH NATIONAL FOREST  
THE ALASKA REGION

REFORESTATION AREAS  
KENAI LAKE BURN  
KENAI DISTRICT